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Monitoring Lake Sinclair

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Monitoring Algal Community Differences Between Eight Sites of Freshwater Reservoir Lake Sinclair

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Introduction

Algae, a polyphyletic group of aquatic primary producers, play a great part in earth's biosphere. They produce half of the world's oxygen and are major contributors to aquatic biodiversity. When conditions are favorable to a species, algae will bloom. Some algal species will produce algal toxins during a bloom as a potential mechanism to concentrate carbon. Due to the integral part they play in aquatic food webs, nutrient cycling and the potential for harmful algal blooms, algal communities are monitored to determine the health and safety of aquatic environments. Lake Sinclair in middle Georgia is a good model where in the same system we can monitor algal biomass in shallow (warmer) and deep (colder) parts of the lake. Fluorometers, like Algaeguard and Benthotorch manufactured by Moldaenke BBE, approximate algal biomass by exciting pigments related to taxonomic groups of algae and measuring the fluorescence that excitation emits (Gregor and Marsalek 2005). Chlorophyll-a, used by all algal groups, is excited by blue light (400-530 nm). Poikane et al. (2014) defined the 'good-moderate' status boundary as 21-23 µg L-1 of chlorophyll a. in shallow lakes, but acknowledged that other factors such as hydrology make it hard to define boundaries across all lakes.

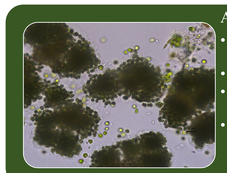
Methods

Collection

- 400ml samples were taken in triplicate at each site monthly from November 2019 October 2020. Shallow site phototrophic zone samples were taken from November 2019 to April 2020. Shallow site composite samples were taken from May to August 2020, deep site phototrophic zone samples were taken for 4 months from May to August 2020. 132 shallow and 48 deep samples were taken in total.
- a Benthotorch Manufactured by Moldaenke BBE was used for *in situ* pigment assays of epilithic/episammic algae
- Physical and Chemical factors(DO, pH, conductivity, and water temperature) were measured using a YSI, manufactured by Environmental Inc., Yellow springs, OH, U.S.A
- GPS coordinates were recorded at each site. See figure 1 for site locations.
- Figure: Benthotorch and YSI

Processing

- 200ml subsample was set aside to perform pigment assays on via Algaeguard, manufactured by Moldaenke BBE (version 2.6 E1)
- Another 200ml subsample was concentrated to 5ml to be viewed via a research grade microscope(Leica DMLB photomicroscope with a Leica DFC7000 GT Camera (Leica Microsystems, Wetzlar, Germany)
- Figure: Algaeguard



Analyses

- ANOVA was performed to determine if there is significant difference between the physical and chemical data from each site
- ANOVA was performed to determine if there is significant difference between Chlorophyll-a concentration at each site
- Microscopy was used to identify and enumerate genera and species found at each site. If less than 20 units is found per transect, the sample was deemed uncountable due to low algal concentrations
- Figure: *Microcystis aeruginosa* as viewed through microscope

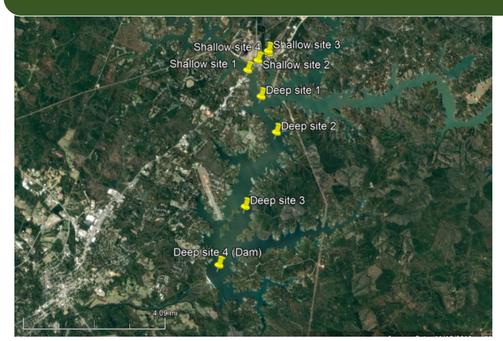


Figure 1:Four shallow sites and four deep sites sampled on Lake Sinclair

Results and Discussion

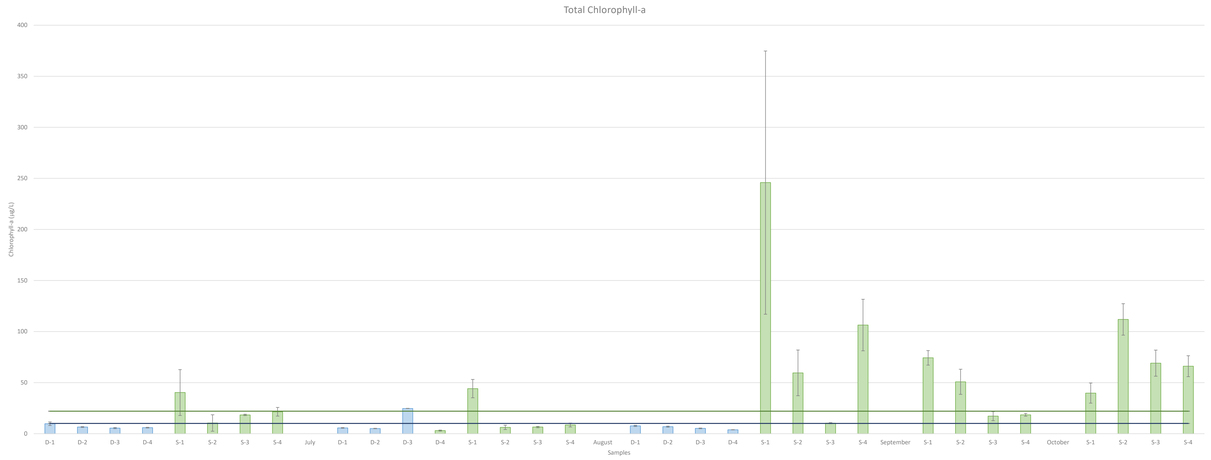


Figure 2: A graph of Chlorophyll-a, an indicator of algal biomass, from June to September 2020, S1-4 are shallow sites D1-4 are deep sites. Shallow sites saw greater algal biomass overall with August through October having the most growth. The lower line represents Poikane et al. 2014 good-moderate boundary for chlorophyll-a in deep water (10µg/L) and the upper line represents the good-moderate boundary for chlorophyll-a in shallow water (22µg/L). One deep site samples and eleven shallow site samples had higher chlorophyll-a concentrations than the boundary and thus do not meet the standards of Poikane et al. 2014

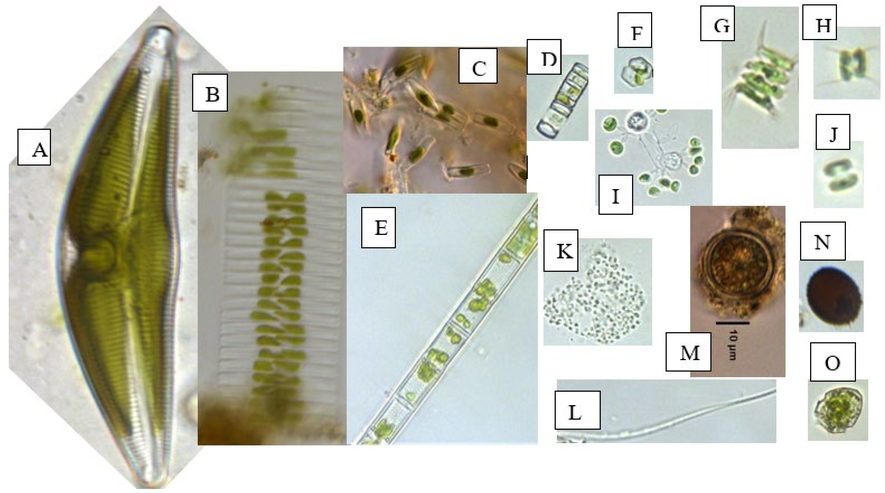


Figure 3: Physiologically active representatives of Lake Sinclair algal community- A-E Bacillariophyceae, Diatoms, F-J Chlorophyta, green algae, K-L Cyanobacteria, M and O Dinoflagellate, and N. Euglenophyta. A. *Cymbella aspera* (Ehrenberg) Cleve; B. *Fragilaria sp.* chain formation; C. *Achnanthidium minutissimum* (Kützing) Czarnecki multiple cells in valve view, D. *Aulacoseira pusilla* (F.Meister) A.Tuji & A. Houki; E. A. *granulata* (Ehrenberg) Simonsen; F. Euastrum sp.; G. *Desmodesmus quadricauda* (Turpin) Brébisson; H. Desmodesmus sp.; I. *Dictyosphaerium ehrenbergianum* Nägeli; J. S*cenedesmus ecornis* (Ehrenberg) Chodat; K. *Aphanocapsa elachista* var. *conferta* West & G.S.West; L. *Leptolyngbya sp.;* M. *Peridinium sp.*; N. *Trachelomonas sp.;* O. *Parvodinium inconspicuum* (Lemmermann) Carty. Scale bar in M applies to all images and is 10 µm.

- 79 samples had too low algal concentrations to count. 60 of these samples most likely had low concentrations due to the sampling method of taking a photic zone sample. In May, the sampling method was switched to taking a composite sample which increased the concentration of algae in each sample. Low concentrations may have also been due to high pH and low light availability. November, January, June, July, and September each reported pH above 8.5 and November 2019 through June 2020 and September and October 2020 saw opaque water due to suspended sediment.
- Algal species capable of producing toxins occurred in 88% of countable sites, although not in high enough concentrations to induce toxin production.
- Four out of seven major groups of algae were represented in these samples
- 8.33% of deep samples and 55% of shallow samples surpassed the good-moderate boundary defined by Poikane et al. 2014. According to Poikane et al. sites surpassing the boundary had an increased chance of producing algal blooms. The samples which surpassed the boundary were concentrated in August, September, and October. No algal blooms were reported during those or an of the months during this study.
- Sites were dominated by pennate diatoms, chain-forming diatoms, green algae, and cyanobacteria. Colony formation and presence of spines was common as would be expected of algae adapted for floatation in the photic zone.
- Cymbelloid diatoms were found in 60% of countable sites and were never found in deep sites.
- Centric diatoms and desmids were found in 96% of countable sites.
- Dinoflagellates were found in 72% of countable sites.
- Euglenoids were found in 36% of countable sites. Euglenoids are often high-nutrient preferring taxa.
- ANOVA of physical and chemical factors found no significant difference between sites in terms of algal biomass, pH, water temperature, conductivity, or DO. This suggests that all sites tested presented a similar environment.
- ANOVA of chlorophyll-a found no significant difference between sites in algal biomass, suggesting that sites tested produced a similar amount of algae growth likely because the physical and chemical factors of each site were similar.

Acknowledgements:

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References:

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